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WALLACE H. COULTER SCHOOL OF ENGINEERING
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MEMORANDUM

Subject: Progress Report 014–
Chaotic LIDAR for Naval Applications: FY14 Q2 Progress Report (1/1/2014– 3/31/2014)

This document provides a progress report on the project "Chaotic LIDAR for Naval Applications" covering the period of 1/1/2014–3/31/2014.

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FY14 Q2 Progress Report: Chaotic LIDAR for Naval Applications

This document contains a **Progress Summary for FY14 Q2.**

Progress Summary for F14 Q2:

Work performed in this quarter focused on using the chaotic lidar system as a channel identification tool, with the goal of measuring the modulation frequency response of the underwater channel over a wide, continuous frequency range.

The chaotic lidar transmitter was coupled with an adaptive receiver to attempt this measurement; the following notes detail the experiment progress in this quarter.

Channel Identification Experiment:

Anticipated:

- Frequency response of any EO system will be visible when probed by chaotic transmitter and processed by adaptive receiver.

Actual:

- Digital, analog, and optical systems all seem to work
- Water system response varies with turbidity, but not as expected
- Need to confirm response using VNWA / FDR to see,
    - Is experimental setup responsible for the "incorrect" response?
    - Is chaotic doing something that is resulting in a fundamentally different measurement?

Concept:

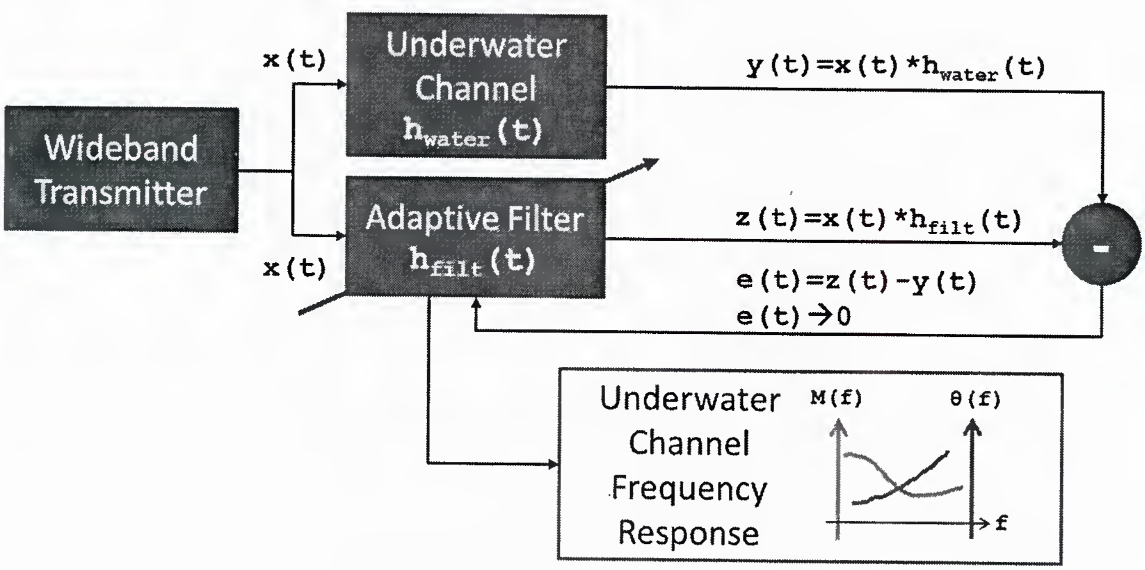
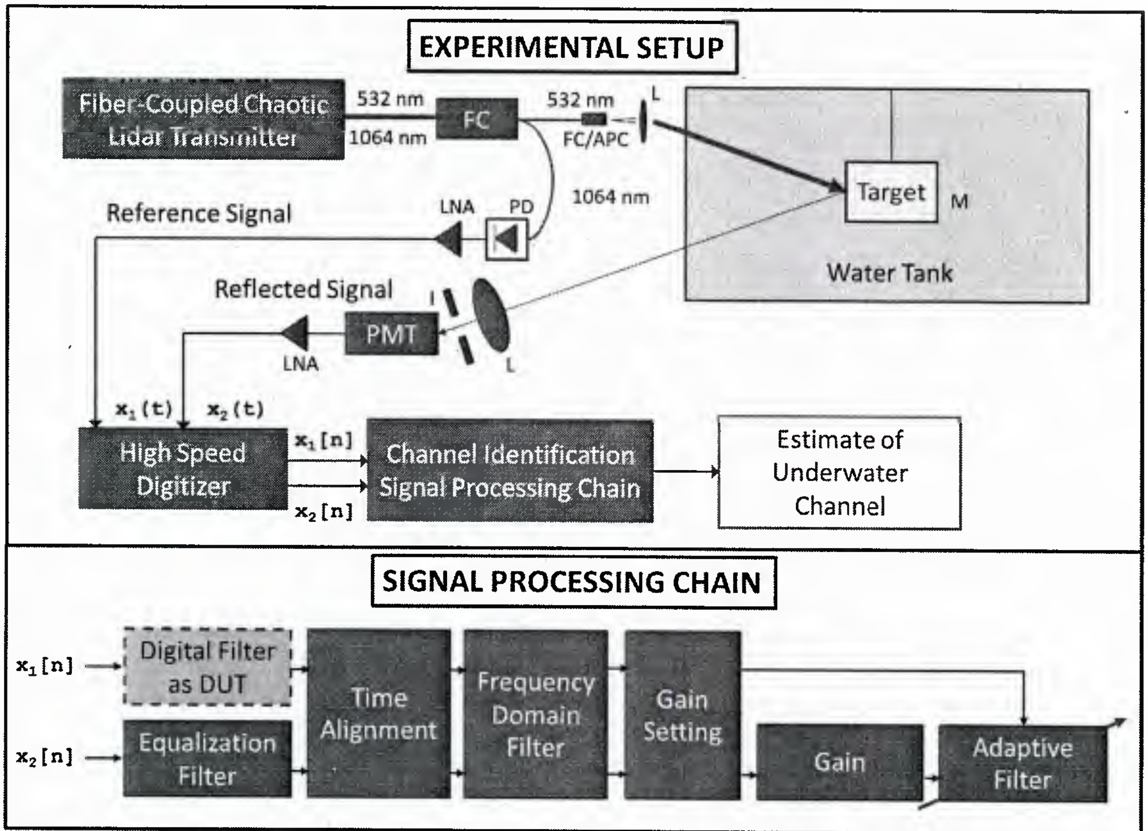


Fig 1. Concept block diagram

Setup:



FC: Fiber coupler; L: Lens; PD: Photodiode; M: Mirror; LNA: Low-noise amplifier; PMT: Photomultiplier tube; DUT: Device under test

Fig 2. Experimental setup block diagram

Details of tank setup:

- Transmitted beam is injected from above and directed down length of tank by two 45° plate mirrors
- Received beam/scatter is sent back by same two mirrors
- The first 0.9 m of the optical path are in air, 2 m path through water

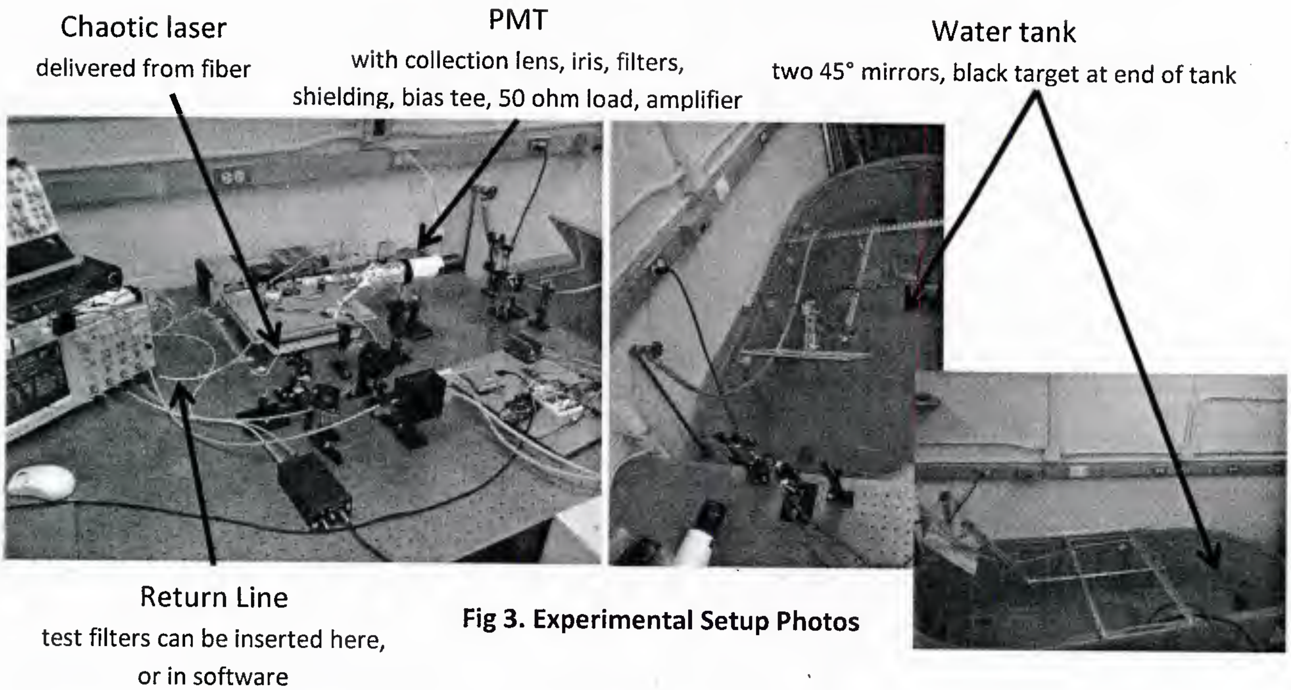


Fig 3. Experimental Setup Photos

Predictions:

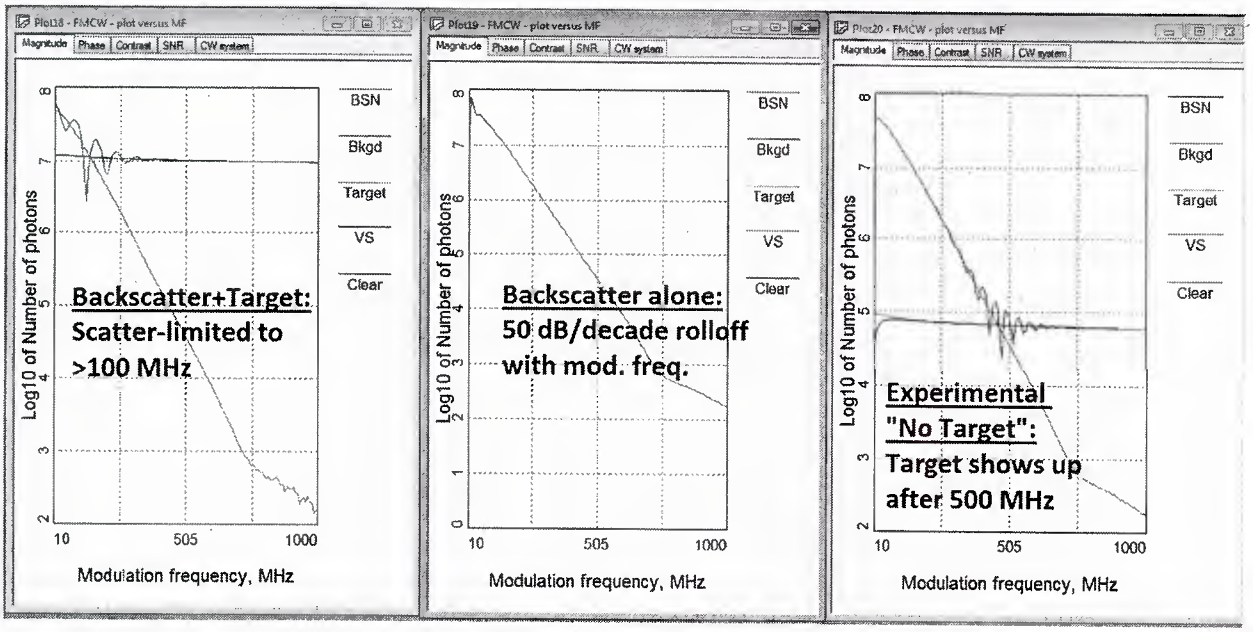


Fig 4. Rangefinder Predictions: Expected frequency response of backscatter with and without target

Parameter	Experimental	Rangefinder
PMT FOV	7° (maximum open iris)	7°
TX-RX separation	10 cm	0.1015 m
RX angle slope	5°	5°
Source power	1 mW	1 mW
Water turbidity	Varied 0.5/m to 8/m	2.5/m
Wavelength	532 nm	532 nm
	Backscatter + Target scenario	
Target albedo	0.9 (white paper)	0.9
Target distance from TX/RX	Varied 1.2 to 1.7 m (0.3 to 1.0 m were in water)	2 m
	Backscatter Alone scenario	
Target albedo	X	0.9
Target distance from TX/RX	X	1000 m
	Experimental "No Target" scenario	
Target albedo	0.05 (black plate at back of tank)	0.05
Target distance from TX/RX	3 m (2 m were in water)	3 m

- Data:

  - Proof of concept:
    - Digital, Analog, and Optical are shown below

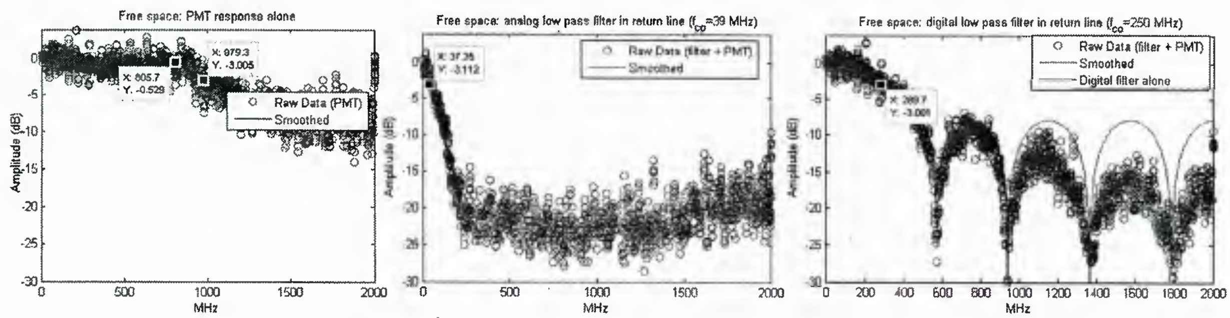


Fig 5. Proof of concept using free space and various devices under test

  - Water:
    - Experimental "No target" scenarios
      - black plate on back wall
      - goes through 2 m of water each way
      - target response is very small
    - No real change in frequency response with increasing turbidity
    - Definitely not 50 dB/decade rolloff!

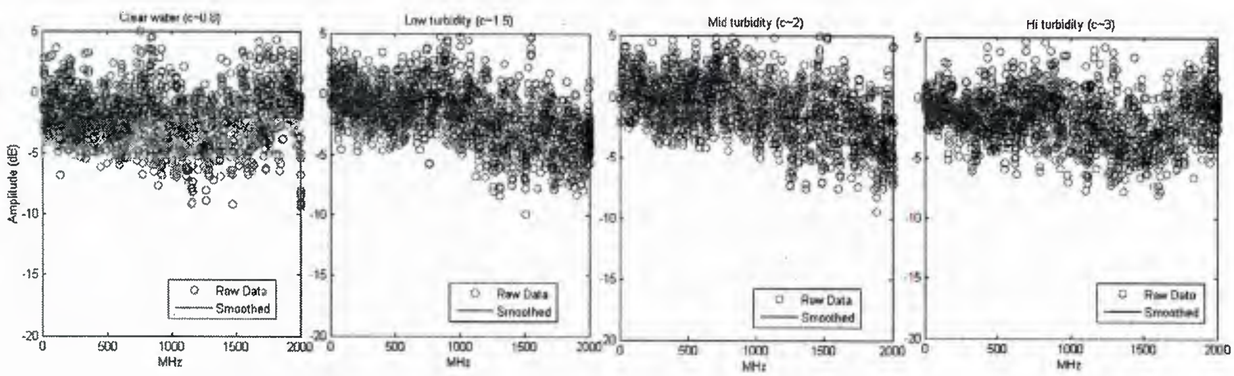


Fig 6. Showing minimal effect of water turbidity on frequency response